STS-106

Flight Readiness Review

Approach and General Description

SR&QA held reviews in preparation for the STS-106 Flight Readiness Review on 14 August and 24 August 2000 and is ready to proceed toward launch countdown.

FRR Briefing OVerview

- **Significant assessments - *discuss***
- **Special topics**
  - **NASA Safety Reporting System (NSRS) - *discuss***
  - **Hazard Analysis - *discuss***
  - **Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) - *discuss***
- Significant Open work - *none*
- *CoFR Exceptions - none*
- Open Action Items - *none*

Significant Assessments

Orbiter

- **Ku-Band Radiating Inside the EVA Box During STS-101**
  - No ISS Hardware concern for STS-106
  - Ku-Band radiated RF power level in RF protect box does not pose a risk to EVA crewmembers or EMU
    - Power density from Ku-Band 15 GHz radiation is 30 mW/cm^2
    - Ku-Band can not radiate for more than 0.03 minutes in RF protect box, more than a factor of ten below crew safety limits
  - The Instrumentation & Communications officer will manage the Ku-Band system by using stored program commands to preclude RF radiation while pointing into the RF protect box

Significant Assessments

Orbiter (continued)

- **RCC Panel #7 Found Damaged Post STS-101**
  - Implemented corrective actions for gap filler installation prior to STS-106
    - Added position markings to aid in position verification
    - Certified technicians reinstalled and tested the RCC panels and replacement gap fillers
  - Tested and inspected surrounding structural hardware and is acceptable for flight
- **Anti-Flood Valve Contamination Found Post STS-101**
  - No risk of particle ignition impact from SSME operation
  - Any remaining contamination is too small to restrict flow through the flow control valves
  - No evidence of contamination on STS-106

Significant Assessments

EVA

- **Oil Contamination of the EMU Oxygen Systems**
  - Cleaned all STS-106 Secondary Oxygen Pack (SOP) regulators prior to flight
  - Primary Life Support System (PLSS) testing demonstrates that ignition is highly improbable
  - Controls are in place to preclude future occurrences
  - SR&QA will issue a Safe ALERT when root cause is identified

ET

- **Weld Bead Dressing**
  - Sanding/shaving weld bead penetrant indications could result in unacceptable weld strength
  - Discovered during NASA Engineering Quality Audit (NEQA)
  - STS-106 welds meet initial weld properties with shaved beads
  - Test and analysis demonstrate positive margins of safety for all welds

Significant Assessments

SRB

- **CDF Initiator Electrical Bond Check Not Performed**
  - Initiators installed on STS-106 forward BSM and Nose Cap thrusters
  - Worst case failure effect is criticality 1, premature operation leading to loss of crew/vehicle
  - Rationale for Flight
    - To date 768 aft BSM CDF initiator installations have been checked and none have failed the electrical bonding requirement
      - Using statistical analysis, probability of achieving an electrical bond is 0.9991
    - The design and installation processing of the forward CDF initiators are the same as the aft BSM initiators
    - CDF initiator mating surfaces are metal to metal contact
    - Testing confirmed insensitivity to electrostatic discharge

Significant Assessments

SRB (continued)

- **Forward Skirt Range Safety System Transition Assembly Weld Anomaly**
  - Suspect welds are not full penetration welds
  - Criticality 1 – Loss of thermal protection resulting in debris generation and possible hot gas path to RSS cables
  - Welds are in a low stress area
  - Re-verified flight environment loads
  - Proofload tested assemblies from the same buy to worst case conditions

SSME

- **Engine 0523 Mishap**
  - Premature cutoff during a test at SSC was due to a violation of the High Pressure Fuel Turbine discharge temperature LCC
  - Failure analysis identified cause of shutdown to be “LOX Tape”
    - Used to cover open orifices during processing

Significant Assessments

SSME (continued)

- **Engine 0523 Mishap (continued)**
  - Criticality 1 Failure Mode
    - Failure of HPFT/AT turbine blade airfoils could result in rotor imbalance and pump failure resulting in uncontained engine damage and loss of vehicle
  - To re-verify barrier removal, all joints where contamination barriers were used for STS-106 were identified and inspected
  - One joint, O2, LPOTP discharge duct to LPOTP, could not be inspected
  - Rationale for not opening joint O2 was approved by the SSP
    - No joint lapping during processing
    - Temporary closures used and vertical orientation makes FOD introduction difficult
    - Temporary closure prevents bolt installation
    - Joint easily inspected and verified during assembly
    - Joint passed bubble leak check and encapsulation test

ADDITIONAL ASSESSED ITEMS ARE IN THE BACKUP CHARTS

NSRS Summary

There are no NASA Safety Reporting System reports open that are applicable to STS-106.

Hazard Analysis Summary

There are no new Accepted Risk hazards identified for STS-106.

FMEA/CIL Summary

Orbiter

Five failure modes associated with the landing gear circuit

- A one flight waiver to CIL submittal requirements has been approved by the PRCB to allow time to document new CIL failure modes
  - Two existing connector failure modes undocumented for MEDS configuration
    - Nose Landing Gear extension pyro assist circuit
      - Connector plug inadvertent demate, Criticality 1/1
    - Main Landing Gear down command circuit
      - Connector plug pin-to-pin short, Criticality 1/1
    - Risk assessment
      - Reliable connector design with robust test and inspection
      - Visual inspection of STS-106 confirmed connector mate and locking bayonets visible for the NLG extension pyro circuit
      - Exposure is less than one minute for the MLG pin-to-pin short and requires worst case flight profile

FMEA/CIL Summary

Orbiter

Five failure modes associated with the landing gear circuit (continued)

- Three new failure modes associated with the MLG down control circuit
  - One new relay short to structure failure mode for the MLG down control circuit
    - Latching relay prematurely closes deploying MLG as soon as “arm” command is set, Criticality 1/1
  - Two new diode failure modes, end to end short and short to structure for the MLG down control circuit
    - Blocking diode failures combine to disable the MLG extend valve (loss of hydraulic deploy), Criticality 1R3
  - Risk assessment
    - Reliable connector and diode design with robust test and inspection
    - No flight failure history

STS-106 Readiness Statement

With the satisfactory completion of identified open work, Safety, Reliability, and Quality Assurance has no constraints to STS-106. SR&QA has no issues that constrain any of the mission success criteria.

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STS-106

Flight Readiness Review

Backup Package

Additional Assessments

Orbiter/GFE

- First flight of Advanced Master Events Controller (AMEC)
- STS-101 Left Orbital Maneuvering System (OMS) Bi-propellant Valve Anomaly
- STS-101 Meds Multifunction Display Unit (MDU) Crt 1 And 2 Innocuous Events
- STS-101 Speedbrake Channel 3 Pressure Hesitation During FCS Checkout
- RMS MPM Stow Problem
- OV-102 Main Landing Gear (MLG) Bungee Rivet Failure
- OV-105 LP04 Oxidizer Tee Assembly Pinhole Leak
- Landing Gear Inadvertent Demate/hydraulics System 2 Nose Landing Gear Deploy
- OV-105 ODS Petal #2 Alignment Anomaly
- Improper Rigging Of Skygenie During Post Landing Egress Training
- OV-104 Left Orbital Maneuvering Engine (OME) Gimbal Actuator Noise
- Quality Control Cleaning Corporation Issue
- Night Crosswind Limit Expansion For Transatlantic Abort Landing (TAL) Sites
- Collins Tactical Air Navigation (TACAN) Concern
- OV-104 Liquid Hydrogen (LH2) Manifold Convolute Pinhole

Additional Assessments

Orbiter/GFE (continued)

- Main Hydraulic Pump Depressurization Piston Cap Bolt Configuration
- Launch Window Management
- NSTS 8080-1 Waiver, Standard 134, Electrical Power Distribution Circuits – Overload Protection For The Orbiter Space Vision Unit (OSVU)
- MPS Fill And Drain Valve Loose Shim
- CRES/IRED Acceptance Rationale

ET

- Aft Fairing Closeout
- Thrust panel penetrant inspection

SSME

- HPOTP/AT Joint G3 Blistered Seal
- QCCC Cleaning Issues
- Anti-Flood Valve Contamination

Additional Assessments

RSRM

- First Flight / Critical Process Change
  - Case Buckling Certification
  - Elimination of Requirement to Weekly Verify Sodium Tripolyphosphate Concentration (STTP)
- Corrective Actions for Nozzle Pocketing Erosion
- STS-101 Ignition S&A Device Damaged A-M Motor Armature
- Suspect Paraffin and Silicone Contamination of Flight Hardware
- S&A Barrier Booster Basket Pellet Contamination

SRB

- Drogue Parachute Reefing Line Cutter Shelf Life Expiration
- SWAR Batteries Shelf Life
- STS-101 APU Gear Box Lube Oil Contamination
- Rate gyro assembly (RGA) maintenance requirements not performed
- CDF initiator bond check not performed

Launch & Landing

- Wire Crimping Issue